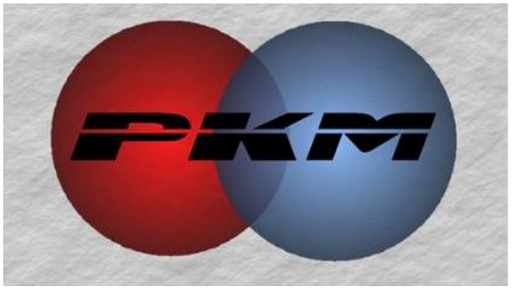

INSTRUCTION MANUAL

EP-KB Series

PRECISION INDUSTRIAL BALANCES

MODELS: EP-12KB
EP-20KB
EP-40KB
EP-41KB
EP-60KB

imno-EP-B-a/b-v.1

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WARRANTY

Warranty rights vary from country to country but it is the general intention of A&D Co., Ltd., to offer customers a one year warranty on this product from the day it is purchased. In some countries consumer protection legislation states that your dealer is responsible for offering a warranty and under these circumstances please refer to your local dealer.

In the U.S.A. the product (if defective) should be returned, freight prepaid by the customer, to A&D Engineering Inc. in California and in Europe the product can be returned freight prepaid to A&D Instruments GmbH in Frankfurt, West Germany. Elsewhere the product can be returned to A&D Co., Ltd. in Japan. In any event please contact your nearest A&D office, before shipping, to confirm that the product is covered by this warranty. Simple repairs can be carried out by your local dealer under warranty and this may be the fastest method of solving your problem.

This warranty only applies to product failures due to defective materials and/or workmanship. This warranty will be rendered invalid if, upon inspection, it is found that the product was: Abused; used for a purpose for which it was not designed; mishandled; placed in a hostile environment; repaired by unauthorized personnel; improperly installed or not adjusted in accordance with instructions given in this manual.

If repair under warranty is confirmed by A&D, then the product will be repaired (or replaced, at the discretion of A&D) and then returned to the customer at no extra cost.

COMPLIANCE WITH FCC RULES

Please note that this equipment generates, uses and can radiate radio frequency energy. This equipment has been tested and has been found to comply with the limits of a Class A computing device pursuant to Subpart J of Part 15 of FCC rules. These rules are designed to provide reasonable protection against interference when equipment is operated in a commercial environment. If this unit is operated in a residential area it might cause some interference and under these circumstances the user would be required to take, at his own expense, whatever measures are necessary to eliminate the interference.

(FCC = Federal Communications Commission in the U.S.A.)

INTRODUCTION

Please read this manual carefully before you use your new balance!

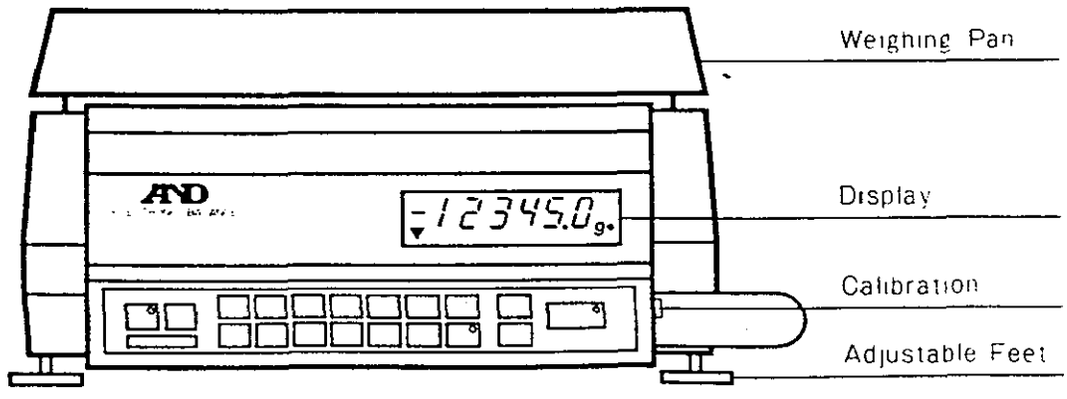
Thank you for your A&D balance purchase! The EP series of high precision industrial balances are the end product of years of research, design, development and in-field testing. Every component has been carefully chosen to permit optimum performance from the entire unit and each balance undergoes several levels of quality control before leaving the factory. The EP series boasts full digital calibration, unit conversion to pounds (avoir) and a host of other features which make for unrivaled specifications.

This Instruction Manual covers the models:

- •EP-12KB
- •EP-20KB
- •EP-40KB
- •EP-41KB
- •EP-60KB

FEATURES:

- ⊃ Ultra stable weighing, high resolution and strong, reliable construction.
- ⊃ Simple calibration via "Full Digital Calibration" function.
- ⊃ Convenient standard output interface, serial RS-232C I/O and Current Loop.
- ⊃ Ability to tare up to the max. capacity of the balance via soft-touch key.
- ⊃ Ability to input a keyboard tare for known container weights.
- ⊃ Ability to set the gram weight of a 100% sample through the keyboard.
- ⊃ Ability to select any counting sample size.
- ⊃ Ability to input the the gram weight value for any calibration mass above 5kg.
- ⊃ Ability to store and recall 5 unit weights in on-board memory.
- ⊃ Ability to input unlimited unit weight/% values through the RS-232C I/O.
- ⊃ Easy-to-read, cobalt blue fluorescent display.
- ⊃ Clear annunciators to indicate the status of various functions.
- ⊃ Optional underhook weighing capability for relative density experiments.
- ⊃ Swing-Arm feature to place the display panel in the most convenient position.
- ⊃ Counting software with "Automatic Counting Accuracy Improvement".
- ⊃ Percentage function and unit conversion to lb, lb/oz, oz (avoir) or troy ounce.



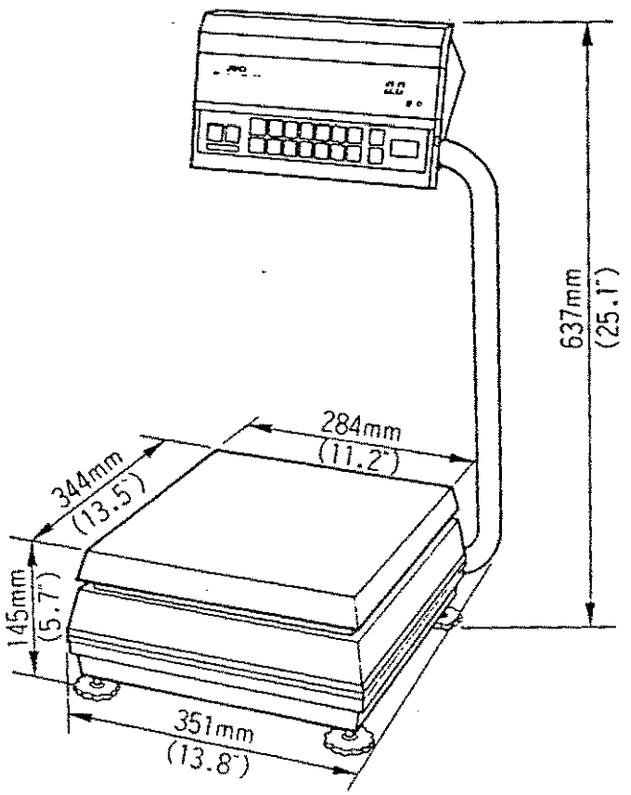
SPECIFICATIONS

BALANCE	EP - 12KB	EP - 20KB	EP - 40KB	EP - 41KB	EP - 60KB
Grams (Max. Cap. x Res.)	12,000x0.1	20,000x0.1	40,000x0.5	40,000x1	60,000x1
Decimal Pound	26x0.0005	44x0.0005	88x0.002	88x0.005	132x0.005
Pound / Ounce	26lb x 0.1oz	44lb x 0.1oz	88lb x 0.1oz	88lb x 0.1oz	132lb x 0.1oz
Decimal ounce (avoir)	423x0.005	705x0.0005	1410x0.02	1410x0.05	2116x0.05
Decimal ounce (troy)	385x0.005	643x0.005	1286x0.02	1286x0.05	1929x0.05
Repeatability Std. Dev.	0.1g	0.1g	0.5g	0.5g	0.7g
Linearity Grams	±0.2g	±0.2g	±0.1g	±1g	±1g
Sensitivity Drift 10-30°C	±5ppm/°C	±3ppm/°C	±6ppm/°C	±10ppm/°C	±6ppm/°C
Resolution Pounds	0.00051b	0.00051b	0.0021b	0.0051b	0.0051b
Resolution lb/oz	0.1oz	0.1oz	0.1oz	0.1oz	0.1oz
Sample 100% Min. Weight	50g/0.01%	50g/0.01%	250g/0.01%	500g/0.01%	500g/0.01%
Sample Counting (10 pcs)	10g Min	10g Min	50g Min	100g Min	100g Min
Counting Capapacity (Max)*	120,000 pcs	200,000 pcs	80,000 pcs	40,000 pcs	60,000 pcs
Stabilization Time	Approximately 3 seconds				
Operating Temp	0°C ~ 40°C (32°F ~ 104°F)				
Pan Dimensions	284mm (W) x 344mm (D) / 11.2" (W) x 13.5" (D)				
External Dimensions	351mm(W) x 434mm(D) x 637mm(H) / 13.8"(W) x 17.1"(D) x 25.1"(H)				
Weight	Approximately 18kg / 39lb 11oz				
AC Input / Factory Set	100, 115, 220, 240, $^{+10\%}_{-15\%}$ VAC (50/60Hz) 12VA				

** Max. count if minimum unit weight placed on pan. Min. unit wt = resolution.*

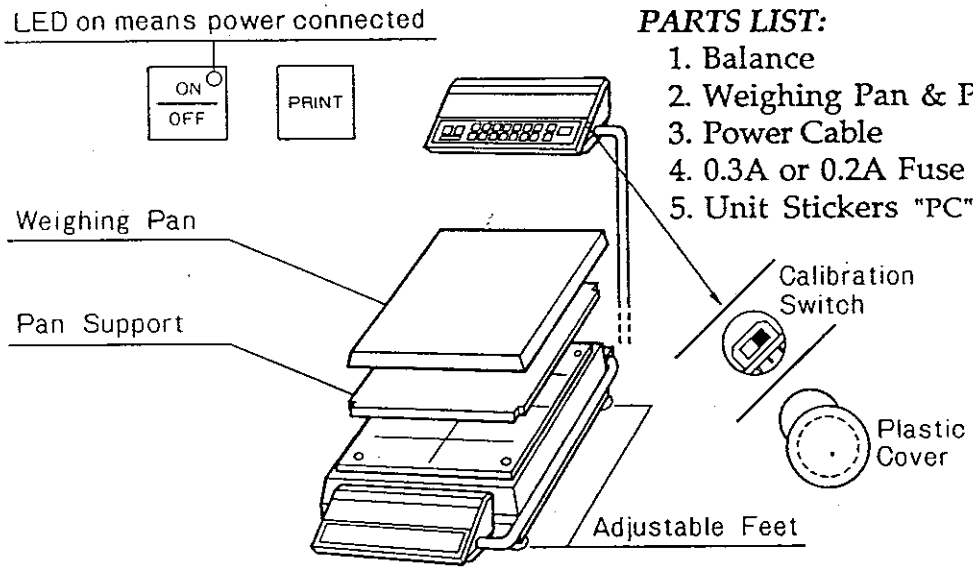
Options Include::

- OP-04 — Underhook for: EP-12KB & EP-20KB
- OP-05 — Underhook for: EP-40KB & EP-41KB
- OP-06 — Underhook for: EP-60KB
- AD-8117 — Compact Printer



INSTALLATION

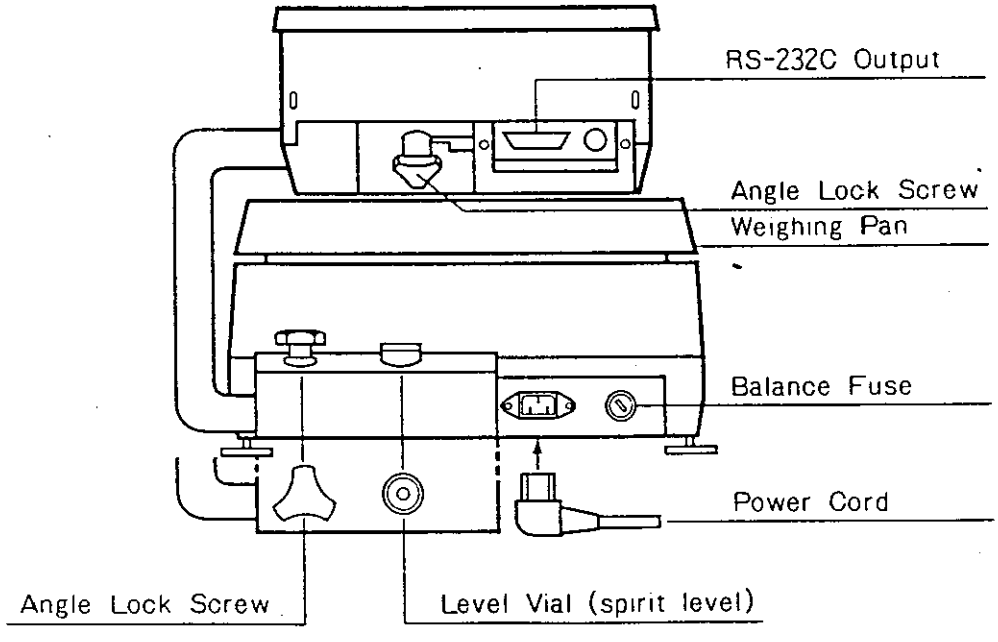
Please see the BEST CONDITIONS FOR WEIGHING section before selecting the installation site for the Balance. • Please unpack the balance carefully making sure that no parts are mislaid during the process, including this manual!



PARTS LIST:

1. Balance
2. Weighing Pan & Pan Support
3. Power Cable
4. 0.3A or 0.2A Fuse (Anti-Surge)
5. Unit Stickers "PC","%","lb","oz","ozt"

- ❑ Place the Weighing Pan, with the Pan Support, gently onto the balance.
- ❑ Level the balance by turning the Adjustable Feet until the spirit level (the little bubble) is in the small circle of the Level Vial.
- ❑ The Display Pod can be: raised, lowered, or the viewing angle adjusted by, loosening or tightening the Angle Lock Screws on the Pod and Balance.
- ❑ The Calibration Switch is situated in a small hole, normally covered by a round plastic cover, near the metal arm that holds the Display Pod. The plug can be removed by gently prying it away from the Pod. Use a small tool to move the switch OFF⇑ (up - normal position) or ON⇓ (down).



Power Requirements

- This balance will accept AC input voltages of; 100, 115, 220 or 240V AC.
- The AC power requirements of your balance are unchangeable, depend upon the original shipping destination of the balance and are clearly marked on the case.
- Power frequency can be either 50 or 60Hz. 0.3A Fuse=100/115V & 0.2A=220/240V.
- Please note that the balance **ON/OFF** key-switch only switches the display on and off, not the power supply for the balance (note that the power LED stays on). The balance may be kept connected to the electricity supply overnight so that a warm up period will not be required each morning. A display of "-----" means that there was a power cut during weighing so press ON/OFF to start again.

Changing The Fuse

* *If the display is blank and the light-emitting diode on the ON/OFF key-switch is not illuminated, a fuse may have blown. Unplug the power cable.*

- If an external AC fuse has not blown and you are certain that the balance is receiving power, the fuse in the balance fuse holder may have blown.
- Turn the fuse holder counterclockwise when opening, clockwise when closing.
- If the fuse has blown, replace it with a 0.3A(100/115V) or 0.2A (220/240V) fuse only. If this fuse immediately blows again, have the balance repaired.

NOTE: ***Uneven illumination of the display segments.***

This condition may be mistaken as a fault but is in fact simply a result of the display not having been run for some time. It may be rectified by running the display with all the segments on until all the segments are evenly illuminated. See the section PARAMETER SETTINGS to learn how to run the display with all the display segments illuminated.

Best Conditions For Weighing

- The weighing table must be of a solid construction and preferably made of a dense non-resonant material. The table should not be used for any other purpose but weighing. If the balance is placed on the floor then care should be taken in its location to make sure that it will not be damaged by vehicles etc.
- Corners of rooms are structurally firm and less prone to vibrations.
- Optimum temperature is about 20°C/68°F at about 50% relative humidity.
- The environment should be kept reasonably clean and dry but do not install the balance near a heater or in direct sunshine.
- The balance must be as level as you can make it so that the mass on the weighing pan can accelerate straight downwards. If the weighing table or floor is not level, turn the adjustable feet on the balance until the level vial indicates that the balance is horizontal.
- Use a damp cloth and mild soap to clean the balance. Do not use solvents.

CALIBRATION

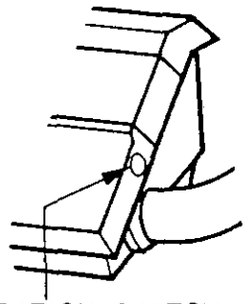
Calibration of the balance is required when it is initially installed, when changing the installation site, and additionally every 90 days or so. It is necessary because the weight of a mass in one location is not necessarily the same in another location. Also, with time and use, mechanical deviations can occur.

"Weight" = Mass x Acceleration due to the field of gravity of the Earth. The internationally adopted value for gravitational acceleration is 9.80665m/s^2 (32.174ft/s^2) in a vacuum, however this varies by about ±0.3% depending on how far you are from the Earth's center of mass. Mass distorts space in such a way that the gravitational power of attraction is inversely proportional to the square of the distance between material objects (if non-gravitational forces are ignored) so gravitational acceleration is greatest at the poles, least at the equator and decreases with altitude. The sun and the moon exert inconstant forces of gravitational attraction. Air buoyancy (approximately 0.0012g ±10% of air displaced per cm^3 at 20°C) and other factors also vary from location to location and from time to time. By using an electromagnet to push up against gravity - then calculating the degree of force (electricity to the magnet) needed to push against a mass - the balance finds the weight of the mass.

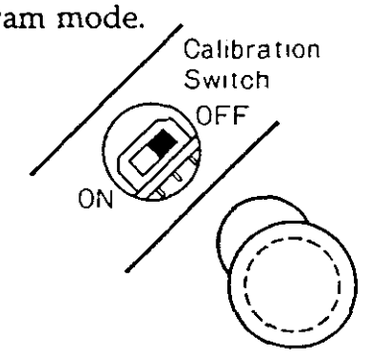
An EP balance is a high resolution instrument so a high quality non-magnetic stainless steel weight should be used for span (maximum capacity) calibration. Steel has a density of about 8.0g/cm^3 which means that a 20,000g mass has a volume of about 2,500cm^3. Thus, 2,500cm^3 x 0.0012g = 3.0 grams of air displaced whereas a brass weight would only displace about 2.8 grams of air unless it had been adjusted via a cavity to mimic steel density. By international convention, weight in air is measured against the buoyant weight of steel in air and EP-20 has a sensitive resolution of 0.1g. EP balances have a very easy calibration method called FDC (full digital calibration) which means that the zero weight point and maximum capacity weight point are acquired digitally at the press of a button. EP-12 requires a calibration weight of 10kg, EP-20 requires a weight of 20kg, EP-40 & 41 require 40kg weights and EP-60 requires a weight of 60kg.

☛*Before calibrating:*

- ❑ Observe all the BEST CONDITIONS FOR WEIGHING.
- ❑ Check that the weighing pan is clean.
- ❑ Warm up the balance for at least 30 minutes.
- ❑ Get it is as level as you can make it.
- ❑ Check that it is weighing in "g" gram mode.



CALIBRATION SWITCH



Plastic Cover

Calibration Procedure

Step 1. With a stable display reading and nothing on the weighing pan, remove the plastic calibration plug on the right side of the display pod. Slide the calibration switch ON (downwards). Do not switch on the calibration switch when the display is off, or "Err C" (for Error in Calibration method) will be displayed.

DISPLAY The display will show "CAL 0".

Step 2. Press the **TARE** key, the display will blank for a few seconds. The "CAL 0" display then returns while the zero weight point is automatically entered by the FDC function.

DISPLAY After zero calibration the display will change to "CAL F" (Full weight).

Step 3. Place the Full Load (the 10, 20, 40 or 60kg maximum capacity weight) on the balance and press **TARE** again.

- EP-12KB **10kg**
- EP-20KB **20kg**
- EP-41KB **40kg**
- EP-40KB **40kg**
- EP-60KB **60kg**

DISPLAY As before the display will blank for a few seconds. The "CAL F" display then returns while the maximum capacity weight point is entered.

DISPLAY Finally the display will show "CAL End" to show that calibration has ended.

Step 4. Switch the calibration switch off and replace the plastic plug, the display will blank and then revert to normal weighing mode. Calibration was easy wasn't it!

NOTE A: If you observe a display of "CAL E" it means Calibration Error because there is too much weight on the pan. Likewise a display of "–CAL E" means Calibration Error because there is too little weight on the weighing pan. A display like this would occur if you placed an incorrect calibration mass on the weighing pan.

NOTE B: If the weight value of your calibration mass has been defined by your local weights and measures authority, then you can program the balance to read the defined weight value of your mass (eg: 20,000.5g instead of 20,000.0g). Please see the Appendix at the end of the manual for programming this value through the keyboard. In fact, any size mass from 5,000g upwards can be used but a mass close to the maximum capacity of the balance is best. If you try to program the use of a mass over the maximum capacity or under 5,000g for calibration, the display will flash "Hi" or "Lo" to warn you.

NOTE C: If you wish to use pound weights to calibrate this balance you will first have to calculate the exact gram value of the mass and then enter this gram value into the balance. For instance if you wish to calibrate EP-20KB with a steel pound weight of 40.00045 lb exactly, then multiply this by 453.59237g to find the gram value of 18,143.9 grams and enter this value through the keyboard before zero calibration (see Appendix for method).

PARAMETER SETTINGS

When the balance is shipped all the parameter settings are set to status 0 for groups "A" and "b" (see table below) and they may not need to be changed. Group "A" settings cover the motion detection band width, The display update rate, the integration time and running the display segments continuously for even illumination. Group "b" settings cover the printing mode, data output baud rate, parity setting and data format concerning the built-in RS-232C interface. Please see the PARAMETER "A" & "b" SETTINGS sections following this section for more information.

A-	0		0		0		0		0	
Group A Settings	Motion Band Width		Display Update Rate		Integration Time Setting		All Segments Illuminated		Do Not Use	
A	0	± 1 digit	0	1/3 sec.	0	6 sec.	0	OFF	0	Always!
	1	± 2 digits	1	1/6 sec.	1	3 sec.	1	ON		
	2	± 4 digits			2	1.5 sec.				
b-	0		0		0		0		0	
Group b Settings	ZERO Band		Print Mode Auto • Manual		Data Output baud rate		Parity Bit Setting		Data Format Stop bit	
b	0	± 2% *	0	Stable Print	0	2,400 baud	0	EVEN	0	7bit • 1bit
	1	± 100% *	1	Print Accept	1	1,200 baud	1	ODD	1	7bit • 2bit
		*of capacity	2	Auto Print	2	600 baud	2	Nothing	2	8bit • 1bit
			3	Command Md					3	8bit • 2bit
			4	Stream Mode						

To enter parameter setting "A" and "b" mode:

Step 1. Switch OFF the display via the ON/OFF key. Next press the TARE key and while continuing to press TARE you should switch the display ON again via the ON/OFF key.

DISPLAY The display will show "A" - 00000" with a triangle below the "A". If you now press the TARE key the triangle will move one step to the right and will be placed below the first (left hand) "0".

Step 2. This means that you can now set this digit to the number you want (with reference to the table below) by pressing the PRINT key once for the figure 1 and twice for the figure 2 etc. eg. "A - 20000".

Step 3. Press TARE to move the triangle cursor to the right and set the next digit.

Step 4. Finally when all the digits are set for group "A" you should return the cursor underneath the letter "A" and press PRINT to imprint the memory of the balance with your settings.

DISPLAY The display will change to "b - 00000" for setting the parameters of the RS-232C interface. Set these parameters as before and imprint in memory when the cursor is under the "b" letter.

NOTE: If you wish to change nothing in group "A" or "b" then you can simply press PRINT first while the cursor is still under the letter. You may at some time wish to enter parameter setting mode to check the present settings without changing any of the settings.

Group "A" Settings

Motion Band Width: In a perfect world an object resting on a weighing pan would be completely immobile. Regrettably this is not a perfect world so we must tell the balance how much motion should nevertheless be considered as no-motion. This setting is the Motion Band Width and if the movement of the object on the weighing pan is small enough to be inside this band then the balance will regard the motion as no-motion and switch on the "STABLE" Symbol. The "STABLE" symbol is the triangle at the far left end of the display panel. If the digit at position "A - X0000" is set to 1 then the display will be regarded as stable if the amount of movement when weighing is less than ±2 digits. The position of the changing digits referred to here is of course the far right end of the display, technically known as the "minimum division" position. The minimum division in the case of EP-20 is 0.1 because the balance weighs to a resolution of 0.1g in gram weighing mode. Thus with a setting of ±2 digits the display of EP-20 can change between 1000.2g and 999.8g with the no-motion symbol remaining on. Incidentally if the maximum capacity of an EP balance is exceeded by more than +10 minimum divisions, then the display will blank and "E" will come on to indicate an overload error. A "-E" display indicates an underload error.

Display Update Rate: This is a rather technical setting designed for busy people who consider a display date update rate of 3 times per second a bit slow. Anyway it is possible to increase the display update rate to 6 time per second with a setting of 1 at position "A - 0X000".

Integration Time Setting: This is the period of time in seconds during which the balance adds weight data samples to produce an average sample for display. The number of samples per second is $10^{2}/_{3}$ so during a 6 second period 64 samples will be added to produce an average (mean) sample. A setting of 2 at position "A - 00X00" would mean that only 16 samples would be added during a $1^{1}/_{2}$ second period. Theoretically a longer period would be better.

All Segments Illuminated: A setting of 1 at position "A - 000X0" will keep all the display segments on so the display will burn evenly (see note, page 6).

Group "b" Settings

Zero Band: A setting of "0" at location "b-X0000" means that the ZERO key will only function in a range of ±2% of the maximum capacity of the balance. A setting of "1" at location "b-X0000" means that the ZERO key will function over 100% of the range up to maximum capacity. Thus if the ZERO key is used as a RE-ZERO key to tare the weight of a container, the balance will not display the weight as NET rather than GROSS.

Print Mode - Auto/Manual: In fact the rest of the group "b" settings can be ignored unless you wish to connect a printer or computer to the RS-232C interface. If you connect a printer (AD–8117) or computer, then you can set one of the following five options at position "b - 0X000".

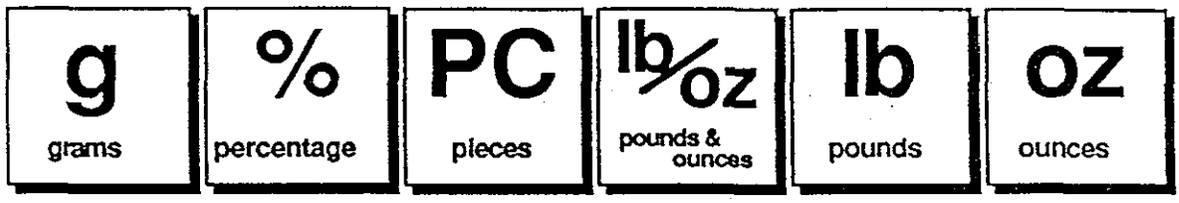
"0" The PRINT key will only work when the display is stable/no-motion.
"1" The balance will accept a print key command but will wait for stable data.
"2" The balance will automatically output stable data once per weighing event.
"3" The balance will output data only when a computer commands it to.
"4" The balance will output a stream of data at the speed of display update rate.

Data Output - baud rate: Different devices require data to be fed to them at different speeds. Some computers may require data at a speed of 600 baud while others may require 2,400 baud. AD-8117 requires data at 2,400 baud.

Parity Bit Setting: This is an error checking system for RS-232C transmission and the setting should be matched to the requirements of the receiving equipment. AD-8117 requires an EVEN parity bit setting; (setting 0 at "b - 000X0").

Data Format Stop Bit: Different equipment will require different data formats. AD-8117 requires 7 data bits and 1 stop bit; (setting 0 at "b - 0000X").

THE WEIGHING MODES



- After setting the parameters of group "A" and "b" (if they need to be changed) you should proceed to set the status of the two extra weighing modes in addition to the basic gram weighing mode.
- At any one time the balance **MODE** key can be used to switch the display from weighing in grams to two of the following six extra weighing modes:
  - "pc." (pieces/counting)
  - "%" (percentage)
  - "lb" (decimal pounds avoirdupois)
  - "lb/oz" (pounds and ounces avoirdupois)
  - "oz" (ounces avoirdupois) or "ozt" (troy ounces).
- Unit stickers have been provided with the balance for sticking on the display panel next to the two extra LEDs located above the gram LED. The two extra weighing modes which you choose to select will depend on the use to which you will put the balance. Some customers will wish to weigh in grams (compulsory mode) or counting or percentage modes while others will wish to weigh in grams or lb/oz or decimal pound modes etc.
  - Top LED- "%" or "pc." or "lb" or "oz" or "ozt"
  - Middle LED- "%" or "pc." or "lb" or "oz" or "ozt"
  - Bottom LED - "g" (cannot be changed)

To enter unit/function setting mode:

Step 1. Switch OFF the display via the **ON/OFF** key.

Step 2. Press the **MODE** key and, while continuing to press **MODE**, you should switch the display ON again via the **ON/OFF** key.

DISPLAY The display will show "---" (no unit) with the middle LED lit. This means you may now define the weighing unit or function for the middle LED.

Step 3. •If you now press the **MODE** key the display will change to "100" for the percentage mode.
- •If you press **MODE** twice the display will change to "PC" (pieces)
- •If you press **MODE** three times "Lb" (avoir decimal lb mode)
- •If you press **MODE** four times "Lb.o" (avoir lb/oz mode).
- •If you press **MODE** five times "o" (avoir oz mode).
- •If you press **MODE** six times "t.o" (troy oz mode).

Step 4. Choose the mode you wish to have at the middle LED position and press the **SAMPLE • %** key to register your choice in the memory of the balance. Stick the correct unit sticker next to the middle LED.

DISPLAY The display will show "---" with the top LED lit. This means that you may now define the weighing unit or function for the top LED.

Step 5. Repeat Steps 3 & 4, this time for the top LED.

Step 6. Choose the mode you wish to have at the top LED position and press the **SAMPLE • %** key to register your choice in the memory of the balance. Stick the correct unit sticker next to the top LED.

Step 7. Next press the **TARE** key and all the display segments will switch on for a short period of time.

NOTE: The balance will remember your choice of units even if the power is disconnected. In normal everyday use you will simply have to press the **MODE** key to switch between the standard gram mode (bottom LED) and the two other modes which you have defined for the middle and top LED's.

WEIGHING UNITS

GRAMS. The primary weighing mode of an EP industrial balance is "g" for grams. This is a unit of mass in the metric (SI) system and is defined as a thousandth part of the International Prototype Kilogram. It is almost, but not quite, the weight of a cubic centimeter of water at 4°C. In fact one liter, one kilogram, of water occupies a volume of 1.000028dm^3 at standard atmospheric pressure of 1.01325 x 10^5 N/m^2. The kilogram (1,000grams) is the SI base unit of mass and is the mass of a platinum-iridium cylinder at BIPM, Paris. An EP balance should be calibrated with a high quality steel weight of the correct number of kilograms. Do not calibrate the balance with pound calibration weights unless you have first calculated the correct gram value for the number of pounds used. For instance if you wish to calibrate EP-20KB with a steel pound weight of 40.00045 lb exactly, then multiply this by 453.59237g to find the gram value of 18,143.9grams and enter this value through the keyboard before zero calibration (see Appendix for method).

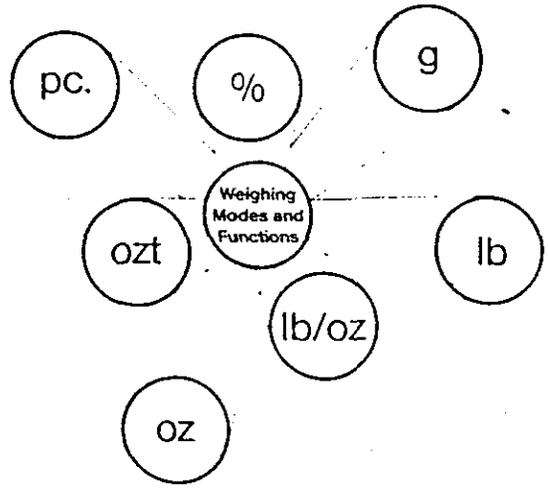
USER SELECTABLE WEIGHING MODES

% OR PERCENTAGE. The "%" weighing mode permits you to use the industrial balance as a sophisticated check weigher. If you use the % mode you may place a sample weight on the weighing pan and press the SAMPLE • % key to tell the balance that the sample weight is the 100% ideal target weight. Subsequently any items placed on the balance will show their deviation from the reference weight in terms of a positive or negative percentage display. Alternatively this mode can be used to turn the balance into a moisture balance — if you enter a moist sample as representing 100% and then dry the sample (via infrared or microwave oven) you will be able to see the percentage of water contained in the moist sample from the percentage weight loss. If you make a note of the gram weight before and after drying the sample, you will also know the volume of water lost because one gram of water equals one milliliter (and virtually equals one cm^3). The numerical keyboard on EP-KB balances can be used to input the exact gram weight value of a 100% sample when in percentage mode, instead of the normal method of placing a sample weight on the pan and then pressing the SAMPLE • % key.

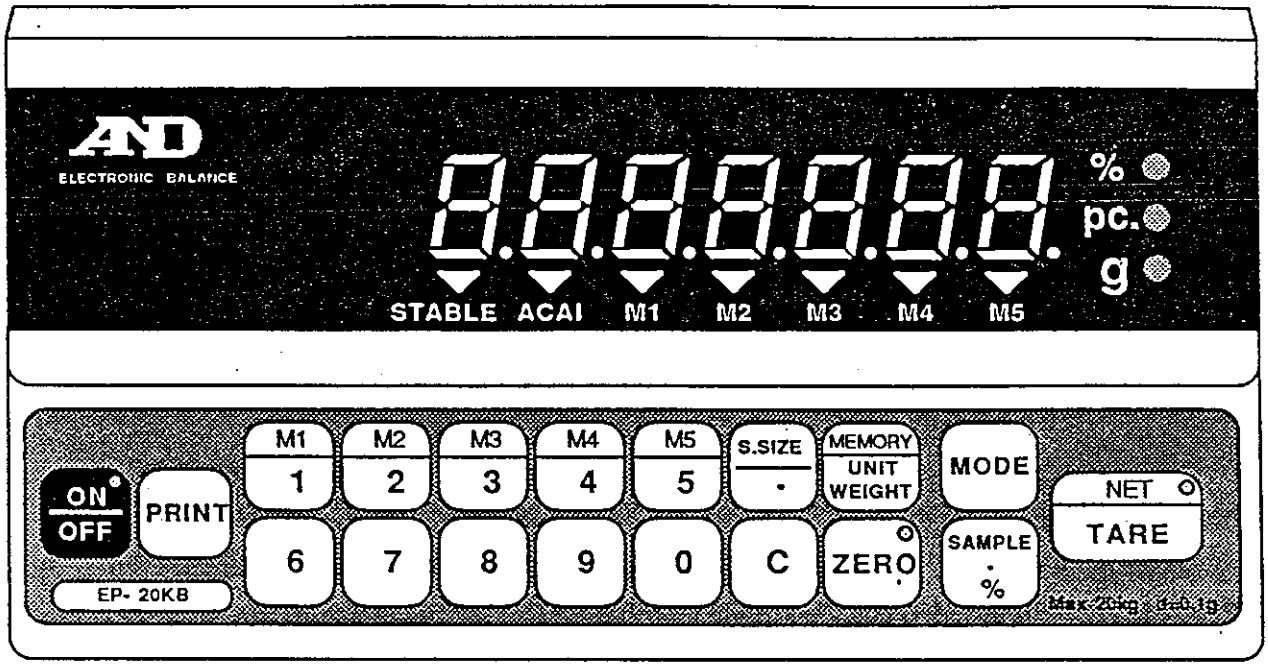
PC OR COUNTING. The counting weighing mode permits you to use the industrial balance as a sophisticated pieces/parts counter in stock control departments. The balance can be used to count leaflets, and electronic or mechanical components. The balance does this is by dividing a sample of 10 pieces by 10 to arrive at the average unit weight of each piece. As you continue to add more pieces to the initial sample of 10, the balance modifies the average unit weight divisor through a software function called ACAI™, or "Automatic Counting Accuracy Improvement". Imagine that 10 pieces weigh 10.0 grams, but a further 10 pieces don't weigh 20.0 grams in total - instead they weigh 20.2 grams — the ACAI function will automatically revise the average unit weight from 1.0 gram to 1.01 grams. In fact, ACAI is more sophisticated than this. Without a function like ACAI, small variations in unit weights could rapidly accumulate into a counting error. The numerical keyboard on EP-KB balances can be used to input the nominal average unit weight value of a sample manually, but of course this method would be less accurate than using ACAI. Keyboard tare should not be tried in counting mode since you would have to input the weight of the container in terms of the number of pieces it represents. Instead, you should place the empty container on the pan before weighing and press the TARE key. The MEMORY/UNIT WEIGHT key can be used to display the average unit weight of a counting sample, to recall the average unit weight in one of the M1 to M5 memory blocks and to enter memory writing mode for count samples. The S.SIZE key can be used to select a different sample size from normal (ie:10 units) and then this will be registered by pressing SAMPLE•%.

lb OR DECIMAL POUNDS. Decimal pounds are a relatively modern invention since pounds (avoirdupois) are traditionally divided by units of 16 rather than 10. The pound can be traced back to Roman times when it was known as the "libra" weight unit and the "lb" abbreviation comes from this ancient unit. The lb is based on the average weight of 7000 grains of English corn (wheat not maize) and one grain unit (gr.) equals 0.06479891 gram. One pound has been defined as being equal to 453.59237 grams so this is the conversion factor used to convert from grams to a decimal pound display. Decimal pounds are used in various industries because of the simple arithmetic involved in adding units of ten. Because 1kg (or 1,000g) is nearly equal to 2.2 lb, the following represents the maximum capacities of EP balances in lb mode: EP-12 = 26 lb, EP–20 = 44 lb, EP-40 = 88 lb, EP-41 = 88 lb and EP-60 = 132 lb.

lb/oz OR POUND/OUNCE. This is the more traditional configuration for the pound (avoirdupois) unit with one pound being divided into 16 ounce units. On the display panel the lb abbreviation has been further abbreviated to "L" so that 10 lb 15.1 oz will be expressed as "10L 15.1" with the "oz" being provided by a sticker next to the middle or top LED. Incidentally data cannot be output via the RS-232C interface in this lb/oz format so it is output as "175.1" ounces instead. One ounce avoir is equal to 437½ grains or 28.349523125 grams and it is also the weight of one imperial fluid ounce of water at 62°F. There are 20 imperial fluid ounces to one pint and 8 pints to one gallon so one gallon weighs 10 lb or 160oz. One US gallon equals about 3.785 liters (3.785 kg) so weighs about 8 lb 5.5oz. Pounds and ounces are used for weighing foodstuffs, mail and other general items. In hospitals EP balances could be used as child/baby scales. The abbreviation "oz" comes from "onza", meaning ounce, in old Italian and there are decimal ounce (avoir) and decimal troy ounce display modes in addition to the lb/oz mode. One troy ounce is 480 grains (31.1034768 grams) and is used for weighing gold and silver.



DISPLAY AND KEY FUNCTIONS


A&D
ELECTRONIC BALANCE
STABLE ACAI M1 M2 M3 M4 M5
%
pc.
g
M1 M2 M3 M4 M5 S.SIZE MEMORY UNIT WEIGHT MODE
1 2 3 4 5 . NET
ON OFF PRINT
6 7 8 9 0 C ZERO SAMPLE . % TARE
EP- 20KB

KEY: | FUNCTION:

ON OFF | This key turns the balance display ON and OFF. The LED annunciator in the upper right corner indicates the balance is plugged in.

PRINT | Can be used to transmit data from the balance through the standard RS–232C and Current Loop interface.

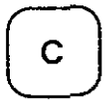
1 Through 0 | The numerical keys can be used to enter a keyboard tare, to enter the gram weight of a 100% sample, to enter an average unit weight in counting mode and to enter the exact weight value of a calibration mass greater than 5,000 grams.

M1 Through M5 | These are five memory locations, to be used with the counting function only, which can store average unit weights. The display indicates which memory location is selected by illuminating the corresponding triangle above the M1 to M5 number.

S.SIZE . | S. SIZE means Sample Size in counting mode and this key may be used to set a sample quantity other than the normal size of 10 units which will be asked for if you press the SAMPLE/% key. At other times this key can be used to insert a decimal point when entering a number through the keyboard.

MEMORY UNIT WEIGHT | This key can be used to open the 5 memory segments in counting mode in which case you can press MEMORY and then M1, M2, M3, M4 or M5 which will recall the previously stored average unit

weight in that segment. After ACAI counting **UNIT WEIGHT** will display the average unit weight of pieces in the sample which can then be placed in memory by opening a memory location (**M1** to **M5**) and then pressing **SAMPLE/%**. The **UNIT WEIGHT** key will also allow you to input a unit weight value through the numerical keys manually.



Clear key for data entry via the keyboard.

This key will return the balance to the center of zero in gross mode if the drift from zero is less than ±2% when the parameter setting mode is set to "0" at "b-X0000" (normal setting). The LED will come on when the balance is at the center of zero ±0.25 digits. In net mode, after taring a container, you may be left with a minus net display - in this case press **ZERO** followed by **TARE** to return the display to zero. Make sure the display is stable before pressing this key.

This key switches the balance between grams and the two other weighing modes which have been selected.

This key can be used to register an average unit weight in memory, to set up the balance to accept a standard sample of 10 units or to prepare it to accept a 100% sample weight.

This key will enter a tare weight value either via the keyboard or from direct reading of the weight of a container on the pan. The **NET** annunciator (LED) will switch on when a tare weight is entered. Make sure the display is stable before pressing this key.

This triangular annunciator flashes when the Automatic Counting Accuracy Improvement function is working.

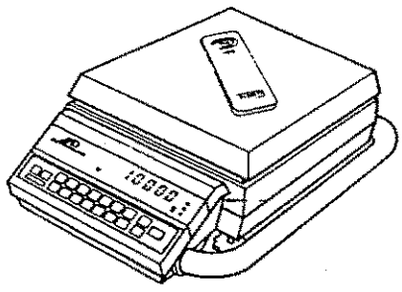
This triangular annunciator comes on when the data displayed is stable or not-in-motion.

NOTE: "GROSS" means all the weight on the weighing pan. "NET" means only the weight of the contents of a container. "TARE" means to deduct the weight of a container from the display. "ZERO" has two meanings: The first is true zero when nothing is on the weighing pan and the display + zero LED shows zero. The second is that the display reads zero (with the zero LED on or off) and something is on the weighing pan --- this could be a NET mode zero or a RE-ZERO zero if the zero key functions over 100% of the range.

OPERATION

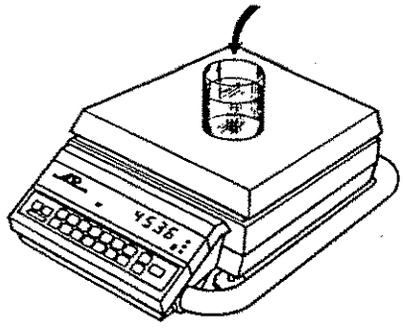
These industrial balances are precision instruments and like all precision instruments, should be treated with a reasonable amount of care. Please take the time to fully read all of the relevant sections before operating your balance.

Weighing



a) Press the ON/OFF key to switch on the display.
b) Weigh in grams or select another weight mode (if available) via the MODE key.
c) Zero the display via the ZERO key and the center of zero LED will switch on.
d) Place the object(s) on the pan and read the weight display when it is stable.

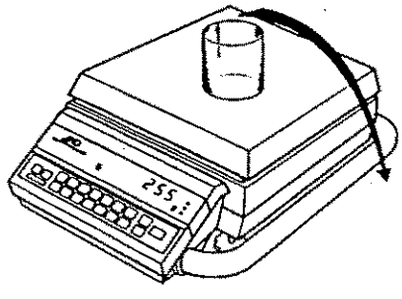
Weighing In



a) Place an empty container on the pan.
b) Zero the display via the TARE key, the NET annunciator will switch on (zero LED off).
c) Fill the container until the target weight is reached.
d) When mixing ingredients in a container press TARE after each addition.

NOTE: Instead of placing the empty container on the pan and pressing TARE, you can enter the weight of the container via the keyboard and then press TARE with nothing on the weighing pan and the weight of the container will then be subtracted and displayed as a minus weight value. This would be useful if you had a number of full containers of identical weight, you were only interested in the NET weight of the contents and you did not have an empty container to use for a normal tare.

Weighing Out



a) Place a full container on the weighing pan.
b) Press TARE to zero the display and place the balance in NET mode.
c) Remove the NET weight of material you need with reference to the negative display.

NOTE: Comparative or deviational weighing can be carried out by pressing TARE with a reference weight on the weighing pan so that similar objects will show their deviation from reference in terms of a plus or minus weight display.

PERCENTAGE FUNCTION

a) Press the **MODE** key to select the "%" percentage function.
b) Press the **SAMPLE • %** key.
c) "100 0" should be displayed but if "100 -" is displayed press ZERO.
d) Place the 100% sample on the weighing pan.
e) The display will show "100 -". Press the **SAMPLE • %** key.
f) The display will blank and then show "100.00", you can remove the sample.
g) The display will zero and subsequent weights will show a percentage deviation from the weight of the initial 100.00% sample.
h) If "Lo" is displayed then the weight is too little to be accepted as a 100% sample. Minimum sample weight is 50g for EP-12/20, 250g for EP-40 and 500g for EP-41/60. The resolution is to 0.01% for all models.

NOTE: The gram weight (only grams) of a 100% sample can be set through the keyboard, followed by pressing **SAMPLE•%**, instead of using the above method.

COUNTING FUNCTIONS

a) Press the **MODE** key to select the "PC" counting function.
b) Press the **SAMPLE • %** key.
c) The display should show "10 0" but if "10 -" is displayed press ZERO.
d) Place your sample of 10 pieces on the weighing pan.
e) The display will show "10 -". Press the **SAMPLE • %** key.
f) The display will blank and then show " 10" for 10 pieces.
g) Add about another 10 pieces and the display will change to show the number of pieces on the pan. The ACAI annunciator will start to flash to show that a new average unit weight is being calculated.
h) If you add slightly more than double the count again you will stay within ACAI parameters but if you add too many pieces at once then the balance can only make an estimated count based on the initial average unit weight. If you exceed ACAI limits then the ACAI annunciator will not flash when you stop adding pieces. Remove enough pieces so that the annunciator starts to flash.
i) If the weight of the initial sample shows less than the minimum unit weight required for 10 pieces (which is 10 times the resolution or 1g for EP-20), then the balance will prompt you to offer a larger sample. The minimum unit weight possible equals the resolution (eg 0.1g for EP-20) but then you will have to hand count a large sample onto the pan (eg 200 pieces for EP-20).
j) If you wish to see the average unit weight of the objects being weighed, press the **UNIT WEIGHT** key and then press the **SAMPLE•%** key to return the display to the number of units on the pan.

NOTE: If you wish to select a sample size different from the standard one of 10 units, you may do so by pressing the S.SIZE key, inputting the sample size you want and then pressing the **SAMPLE•%** key to register your choice when the sample is on the pan.

Setting A Unit Weight Into Memory

To set a unit weight into memory, you must start with a unit weight displayed by either the ACAI procedure above, or by keying in the nominal unit weight value via the keyboard. If you have not done the ACAI procedure above, please enter in a nominal unit weight via the keyboard at this time.

Step 1. Press the desired memory key number (**M1→M5**) that you wish to store the unit weight into.

DISPLAY The display will flash, showing the old unit weight previously stored in memory. If there was no number previously stored the display will read "0".

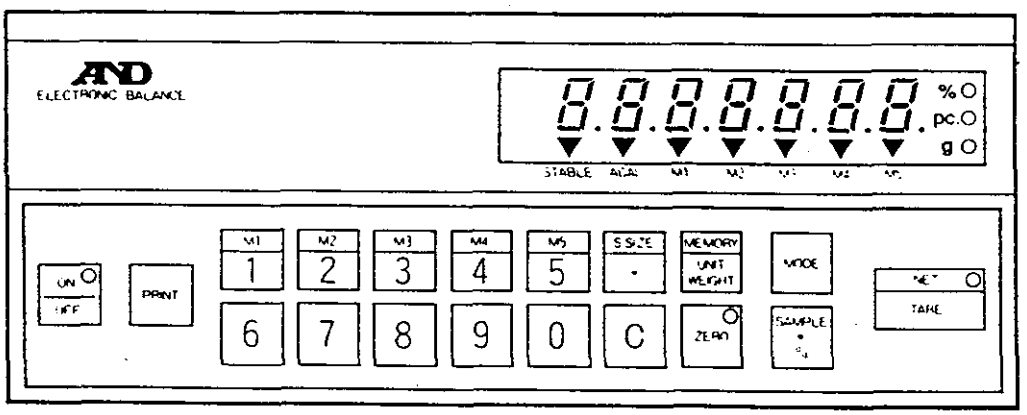
NOTE: If you proceed, you will erase the previously set unit weight so if you wish to exit you may press **SAMPLE•%** now. If you wish to continue but would like to keep the old unit weight for future use - simply write it down and you can enter it manually through the keyboard at a later date.

Step 2. Press the **MEMORY/UNIT WEIGHT** key.

DISPLAY All digits will blink and the new unit weight will be entered into the selected memory space.

Step 3. Press the **SAMPLE • %** key to register the new weight and to get back to normal counting mode display.

NOTE: The memory bank for counting data is limited to 5 sections and this data will be protected even if the power is disconnected. Customers with a large number of different components in stock to count can keep a paper record of the average unit weight of each component and then key this value in via the keyboard prior to counting. This paper record should be periodically checked as the average unit weight will vary between production batches of components. Rather more complex systems can be designed using a computer to send the average unit weight data to the balance through the standard RS-232C interface.



PRINTING WITH AD-8117

Connect the optional compact printer AD-8117 to the balance via the printer's interface cable. Read the following table in conjunction with the Parameter Setting information on pages 9 and 10.

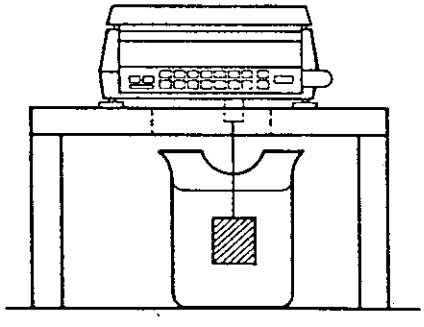
Print Method	Parameter	AD-8117 MODE Key	Description
Balance Print Key	b-00000	MODE 1	The printer will only print after the data has become stable.
Balance Print Key	b-01000	MODE 1	The printer will only print when the data is stable.
Auto-Print (1 per event)	b-02000	MODE 1	The printer will only auto-print stable data once per weighing event.
AD-8117 DATA Key	b-04000	MODE 2	The printer will only print when the printer DATA key is pressed.

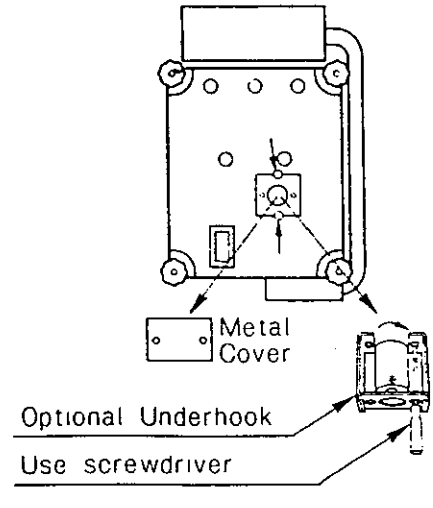
UNDERHOOK WEIGHING

An optional underhook is available for use with your EP Industrial Balance. If you remove the metal cover underneath the balance you will see the attachment point for the underhook. Attach the underhook and place the balance on a weighing table with a hole cut in it through which the underhook and harness can freely protrude. Underhook weighing is necessary if you wish to find the relative density (specific gravity) of a metal or some other material. Because one gram of water is almost exactly one cubic centimeter in volume, the loss in weight (displacement) associated with weighing an object in water is in proportion to its volume. By dividing the object's weight in air by the loss in weight in water, the volume, you can find the object's relative density (expressed as g/cm^3).

AN EXPERIMENT WITH A BAR OF SILVER COLORED METAL

a) Press ZERO to zero the display to the center of zero.
b) Find the weight of the bar in air. Bar weighs 1000.0g in air.
c) Press TARE to zero the display (NET mode).
d) Lower the bar into water at 4°C (maximum density).
e) Display reads "- 46.5" g which is almost the same as $46.5cm^3$.
f) $1000.0g \div 46.5cm^3 \approx 21.5g/cm^3$. Thus the metal is probably platinum.



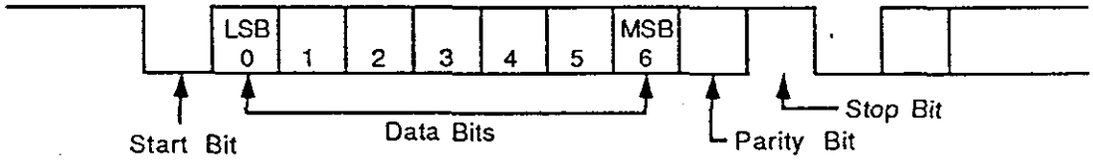


INTERFACE

The built-in interface is a serial RS-232C I/O (+CL) card for connecting EP balances to an AD-8117 Compact Printer or to an external device such as a computer.

Specifications

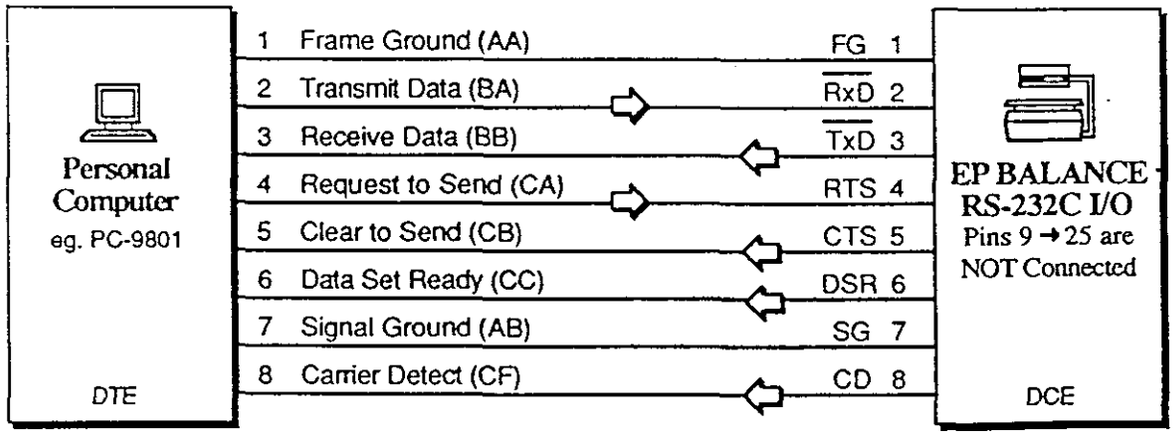
Type	EIA-RS-232C . Passive 20mA Current Loop
Method	Half-duplex, asynchronous transmission, bidirectional
Format	Baud rate: 600, 1200, 2400 (selectable b - 00X00) Data bit: 7 or 8 (b - 0000X) Parity bit: 1 (EVEN/ODD/NOTHING) (b - 000X0) Stop bit: 1 or 2 (b - 0000X) Code: ASCII



RS-232C	20mA Cur. Loop
1 = –5V → –15V	20mA
0 = +5V → +15V	0mA

AD-8117 & Other Devices

The AD-8117 Compact Printer requires data at 2400 baud, 7 data bits, 1 stop bit and an EVEN parity bit. EP balances are designated as Data Communication Equipment for other devices. Please see the following diagram.

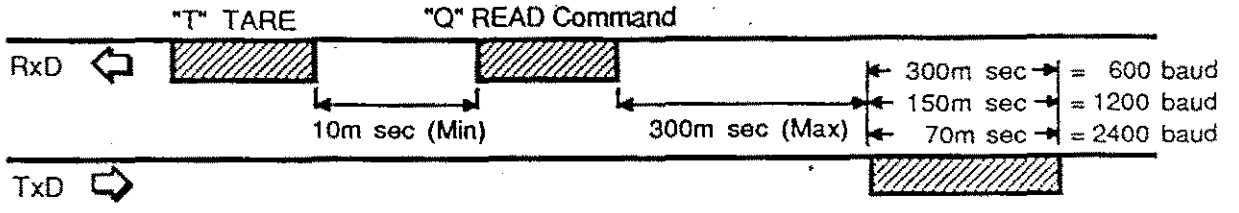


Transmission Modes

(Parameter Setting location b - 0X000)

Two transmission modes are available for computers, one from both RS-232C and Current Loop, "Stream" Mode, and one, "Command " Mode, is only available from RS-232C. In Stream Mode data will be transmitted continuously and in Command Mode data will only be sent when a "READ" command is received from an external device. The other three transmission modes are primarily designed for sending data to the AD-8117 compact printer. See the Parameter Setting section to learn how to set the RS-232C Parameters.

Command Mode Timing (RS-232C)



P CR LF = POWER to the display ON/OFF.
Q CR LF = READ the data. It is a command to the balance to transmit.
S CR LF = READ the data only when the data is stable.
T CR LF = TARE the balance to zero the display (NET mode).
U CR LF = MODE change to change the weight unit or function.
Z CR LF = ZERO the display (GROSS mode).
@ CR LF = REQUEST to transmit the average unit weight.

You may also input a tare weight value in a way similar to a keyboard tare and input the gram weight of a 100% sample or the average unit weight of a component.

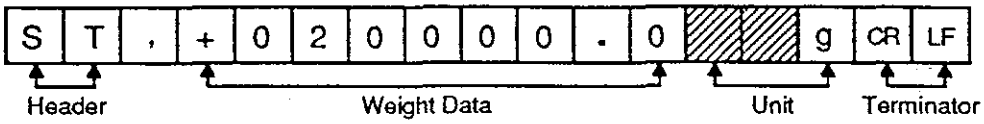
****** CR LF = Input a TARE value (* = number spaces)
@ ****** CR LF = Input a unit weight or 100% sample gram weight.

When a "Q" READ command is received, a weight data sample immediately following the command will be transmitted and no further commands should be sent until after the command has been executed and the data has arrived.

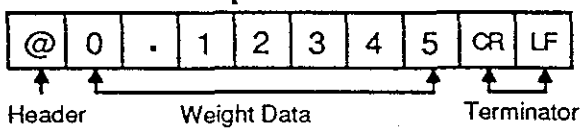
When an "T" TARE command is received the tare function of the balance will be activated. Do not send any further commands until at least 10msec later.

Data Format

Output Format



Input Format



Five types of output HEADER are transmitted:

OL - Overload/Underload (E, -E)
ST - Display is Stable in %, g, lb or oz mode
US - Display is Unstable (in-motion)
QT - Display is Stable in counting mode
UW- Unit Weight follows

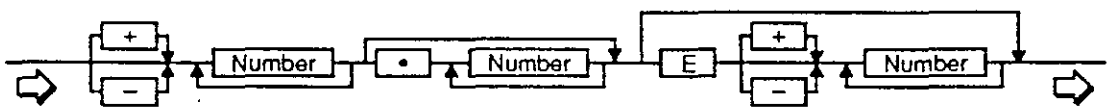
Two types of input HEADER are transmitted:

@ - Unit weight value/100% value follows
# - Tare weight value follows

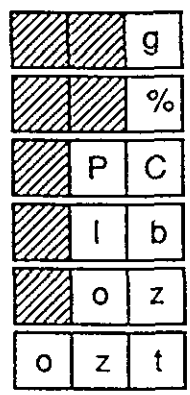
Weight Data samples are transmitted by ASCII numerals including the following codes:

2D (HEX) "–" (minus)
2B (HEX) "+" (plus)
2E (HEX) " ." (decimal point)
45 (HEX) "E" (exponent)

Data may be represented by the following flow diagram :



Display	Transmission Data	
0.0g	+000000.0	xxg
86.00%	+00086.00	xx%
120000PC	+00120000	xPC
–5432.0g	–005432.0	xxg
10.0000lb	+010.0000	xlb
10L 00.0oz	+000160.0	xoz
E	+9999999E	+19
–E	–9999999E	+19

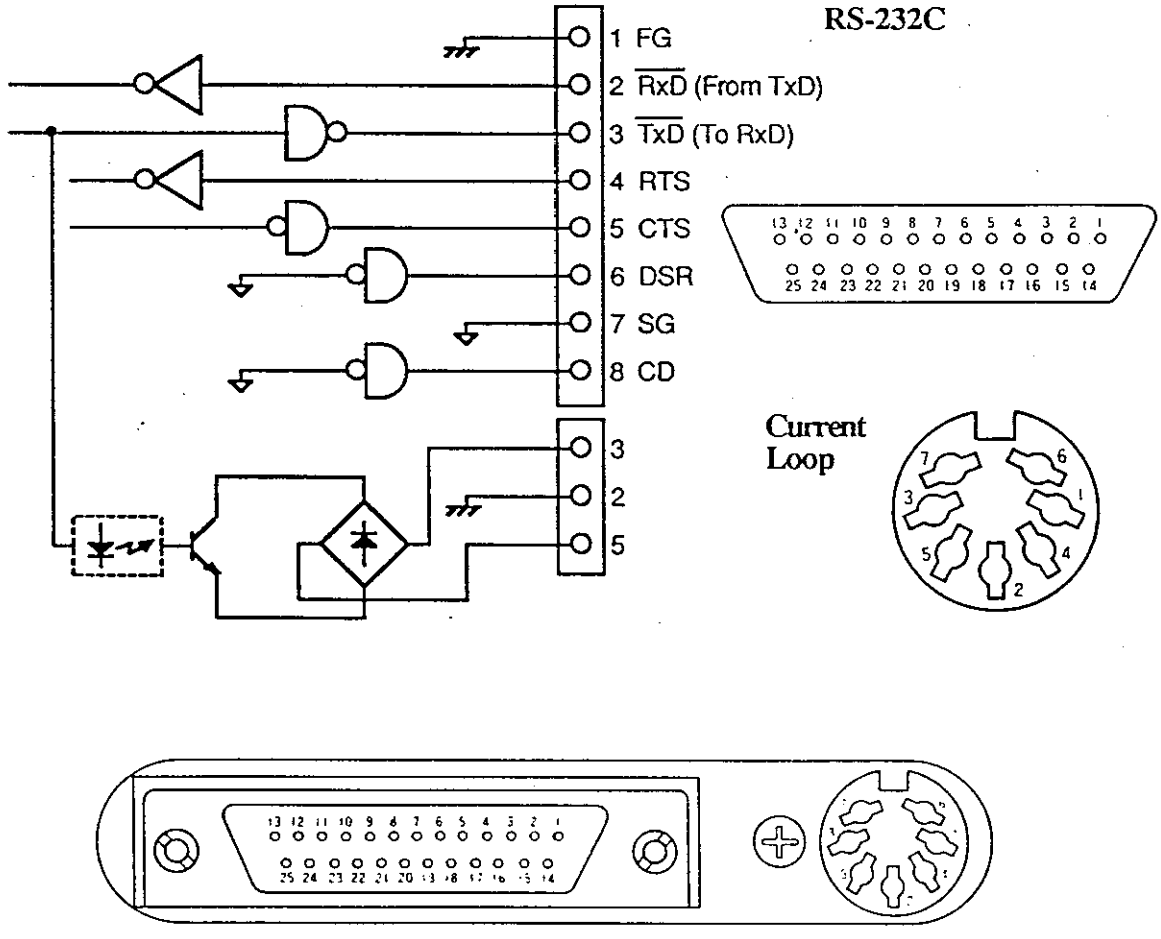


Space / Space / Grams
Space / Space / Percent
Space / Pieces
Space / Pounds
Space / Ounces
Ounces (troy)

Note: For "E" or "-E" the header reads OL for overload.

Circuit Diagram

An RS-232C connector is not provided with the balance because the Compact Printer AD-8117 is provided with a cable and connector. A 7 pin DIN Current Loop connector is provided so that you may connect a computer. Please note that this is a passive current loop which requires an external 20mA power source. If you use AD-8117 (RS-232C) and a computer (CL) together then place the balance in stream mode and the printer in Mode 2; the balance **PRINT** key will not work so use the printer key. AD-8117 can be used via its active Current Loop interface (+ OP-01 cable) if the RS-232C interface should be connected to a computer.



COMPUTER PROGRAMS

If you connect a computer to the balance via the RS-232C interface rather than the Current Loop, then the computer can control data output when the balance is in Command Mode. The programs below are written in Microsoft BASIC for the NEC PC-9801, the Epson HC-20, and the IBM PC-XT. They show how to send a READ command to the balance but please note that your computer may have a different BASIC dialect. The baud rate should be set to 2400 in Command Mode (b - 03000).

PROGRAM FOR PC-9801

```
10    OPEN " COM : E71NN" AS #1          (NN=PC-9801 BASIC dialect)
20    FOR I=1 TO 100 : NEXT I              (DELAY after buffer open)
30    PRINT #1, "T"                              (TARE the balance)
40    FOR I=1 TO 100 : NEXT I            (DELAY after TARE input)
50    PRINT #1, "Q"                          (READ the weight data)
60    INPUT #1, HD$, DT, UT$             (RECEIVE the weight data)
70    PRINT HD$, DT, UT$                 (DISPLAY the weight data)
80    CLOSE
90    END
```

HD$=Header string, DT=Data, UT$=Unit string

PROGRAM FOR HC-20

```
10    OPEN "O", #1, "COM0 : (57E15)"
15    OPEN "I",", #2, "COM0 : "
20    FOR I=1 TO 100 : NEXT I              (DELAY after buffer open)
30    PRINT #1, "T"                              (TARE the balance)
40    FOR I=1 TO 100 : NEXT I            (DELAY after TARE input)
50    PRINT #1, "Q"                          (READ the weight data)
60    INPUT #2, HD$, DT, US$             (RECEIVE the weight data)
70    PRINT HD$, DT, US$                 (DISPLAY the weight data)
80    CLOSE
90    END
```

PROGRAM FOR IBM PC-XT

EP Series Interface Sample Program (left: Stream Mode, right: Command Mode) for IBM PC-XT DOS version 3.10 and BASIC version D3.10. Parameter Setting - left: "b-04000" means "Stream Mode"; right: "b-03000" means "Command Mode". 2400 baud, Even parity, 7 data bit, 1 stop bit.

Stream Mode "b-04000"

```
10  T=5:ON ERROR GOTO
20  OPEN "COM1:2400,,,,CS" AS #1
30  LINE INPUT #1,A$
40  INPUT #1, HD$, DT$
50  IF HD$<>"OL" THEN 70
60  IF HD$ ="OL" THEN 90
70  DT$="      "+LEFT$(DT$,1)+"E":GOTO 90
80  IF HD$<>"US" GOTO 90
90  DT$=LEFT$(DT$,9)
100 PRINT HD$, DT$:GOTO 40
110 REM
120 T=T-1:IF T <> 0 THEN GOTO 30
130 END
```

Command Mode "b-03000"

```
10  OPEN "COM1:2400,,,,LF" AS #1
20  PRINT #1, "T"+CHR$(&HD);
30  PRINT #1, "Q"+CHR$(13);
40  INPUT #1, HD$, DT$
50  IF HD$ ="OL" THEN 90
60  IF HD$<>"US" GOTO 80
70  DT$=LEFT$(DT$,9)
80  PRINT HD$, DT$:GOTO 110
90  EM$="      "+LEFT$(DT$,1)+"E"
100 PRINT HD$,EM$
110 END
```

APPENDIX

PROGRAMMING THE BALANCE WITH THE WEIGHT VALUE OF YOUR MASS

It is important to understand that an electronic balance is only as accurate as the accuracy of the mass used to calibrate it. The EP Industrial Balances are exceptionally accurate instruments but this means that they should receive extremely accurate calibration. Ideally calibration should be carried out at close to maximum capacity because if it is not, span errors can appear. That is, if you calibrate EP-60 with a 10kg (rather than 60kg) mass then all calculations will be based on 10,000g by 1g instead of 60,000g by 1g. This means that although the balance will be accurate (±1g) from zero to 10,000g, there could be a displayed deviation of more than ±1g when 60,000g is placed on the balance. On the other hand a 60kg mass may not always be readily available while a 10kg mass might be and under these circumstances it is possible to calibrate the balance (less accurately) with a 10kg mass.

To summarize, any weight value above 5,000g and up to the maximum capacity of the balance can be used but unless you use a mass close to the maximum capacity, span calibration may not be accurate. If you try to set a weight value which is too low or too high you will be warned of your error with a flashing "Hi" or "Lo" display. A "CAL no" display instead of "CAL End" probably means that there was some vibration during calibration or that the weight value you programmed could not possibly represent the mass on the weighing pan.

Another problem associated with calibration is that the mass may not be as accurate as the balance. If EP-20 was calibrated with a 20kg mass which actually had a true weight value of 20,000.5g, then the balance would have been calibrated out of specifications (±0.1g at 20kg). The error would be in the nature of 20,000.0 into 20,000.5g (1.000025) instead of 20,000.5 into 20,000.5 (1.0). This could have an affect on the minimum division position at weights above 2kg.

Please see the next page for CALIBRATION WITH ADJUSTMENTS.

CALIBRATION WITH ADJUSTMENTS

Step 1. With a stable display reading and nothing on the weighing pan, remove the plastic calibration plug on the right side of the display pod. Slide the calibration switch ON (downwards). Do not switch on the calibration switch when the display is off, or "Err C" (for Error in Calibration method) will be displayed.

DISPLAY The display will show "CAL 0".

Step 2. Press the **PRINT** key. The display will show the ideal weight of the calibration mass which you should use. In the case of EP-20KB this would be "20000.0g". You may now input the actual weight value of of your calibration mass through the keyboard. This might be for instance "20000.5g" or, if you are using a pound weight of of 40.00045 lb exactly, then multiply this by 453.59237g to find the gram value of 18,143.9grams and enter this gram value through the keyboard. If you make an input error then press C followed by **PRINT** to start again. Press **TARE** to return to zero calibration, "CAL 0".

Step 2. Press the **TARE** key again , the display will briefly blank. The "CAL 0" display then returns while the zero weight point is automatically entered by the FDC function.

DISPLAY After zero calibration the display will change to "CAL F" (Full weight).

Step 3. Place the Full Load (the maximum capacity weight) on the balance and press **TARE** again.

- EP-12KB **10kg/20lb**
- EP-20KB **20kg/40lb**
- EP-40KB **40kg/80lb**
- EP-41KB **40kg/80lb**
- EP-60KB **60kg/120lb**

DISPLAY As before the display will blank for a few seconds. The "CAL F" display then returns while the maximum capacity weight point is entered.

DISPLAY Finally the display will show "CAL End" to show that calibration has ended.

Step 4. Switch the calibration switch off and replace the plastic plug, the display will blank and then revert to normal weighing mode.